QUARTERLY REPORT

1. **Contract No.:** DAMD17-91-C-1081

2. **Report Date:** 28 May 1992

3. **Reporting Period:** 16 February 1992 through 15 May 1992

4. **Principal Investigator:** Dr. Robert W. Verona

5. **Telephone Number:** (205) 598-6389

6. **Institution:** UES, Inc.
4401 Dayton-Xenia Road
Dayton, Ohio 45432

7. **Project Title:** Development of Data Packages on the Human Visual Response with Electro-Optical Displays.

8. **Current staff, with percent effort of each on project:**

NAME	TITLE	HOURS*	% OF EFFORT
Dr. Robert W. Verona	Engineering Psychologist	456	89%
Dr. Victor Klymenko	Research Psychophysicist	512	100%
Mr. Howard H. Beasley	Electronics Technician	504	98%
Mr. John S. Martin	Electro-optic Technician	512	100%

* 512 Hours were available during this reporting period not including holidays. The above hours are the actual hours worked (sick leave and vacation time have been subtracted).

9. **Contract expenditures to date:**

Personnel	$224,509.98	Equipment & Supplies	$3,480.89
Travel	$2,749.17	Other	$2,285.70
		TOTAL*	$233,025.74

*Does not include facilities capital and G&A expense.

10. Comments on administrative and logistical matters.

Telephones:

UES reconfigured its telephone system to conform to the revised work areas. Some extensions were removed from areas no longer occupied by UES and relocated to areas now used by the UES staff.

11. Scientific Progress:

Physical Measurements:

A technical paper titled, "Comparison of CRT Display Measurement Techniques," was presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Conference in April 1992. Dr. Verona also participated as a display and night vision technology expert in a panel discussion on related lessons learned from Desert Shield/Storm.

The measurement comparison paper is being expanded with more data for a technical report documenting the differences obtained from using the various display measurement techniques. The most accurate technique had been developed jointly among the services and industry, and reported in USAARL Report Number 79-14, "A Direct Measure of CRT Image Quality." The more expedient measurement techniques tended to under-estimate the display's performance in the medium spatial frequency range and over-estimate the performance in the low spatial frequency range.

The MTF curve normalization process used in many measurement procedures raises the curve and inflates the actual modulation contrast available at all spatial frequencies. The actual modulation capacity of the display is lower than the value predicted by its normalized MTF curve. Lower modulation results in an overall reduction in the number of gray shades presented to the viewer. The modulation contrast reductions at low spatial frequencies are particularly noticeable. The normalization process therefore inflates the display's performance predicted by the normalized MTF curve as compared to a direct sine wave response (SWR) measure.

Set-up of the laboratory space is an on-going effort. The live video from the dual rooftop mounted cameras have been routed into the video source and distribution system. The FLIR ground support equipment, not originally ordered with the FLIR, has been acquired and used to perform the required FLIR maintenance. The FLIR is now operational and its video can be routed through the video distribution system. Eventually the FLIR will be mounted on the roof next to the day cameras.

Additional video test signals have also been added to the video source options. These test signals

are used with the spatial measurement software to measure the display static and dynamic MTF. Various line rates also can be accommodated with the additional test signals.

Modifications to the spatial measurement software have increased its utility and enhanced its self-documentation capability. Further modifications are underway to allow the software to analyze dynamic MTF data. The dynamic MTF photometric data must be captured on a Tektronics digital oscilloscope then transferred to the PC for analysis. The static MTF software did not have the temporal response necessary to acquire the dynamic MTF data.

A model was developed to predict the number of shades of gray from various helmet mounted display configurations under various environmental conditions. The number of shades of gray are significantly reduced with some display/optics configurations. The IHADSS measurement data were used as a baseline. A video tape and photographs were produced to demonstrate these effects.

Psychophysical Measurements:

The optical design was completed for the binocular overlap study. Two different configurations were required to present the full range of spatial frequencies and field-of-views (FOV). Optical components were ordered and the machine shop fabricated the fixtures required to hold the components at precise orientations. One configuration uses the top and bottom halves of the high resolution monitor to present high spatial frequency/wide horizontal FOV stimuli to the right and left eyes, respectively. The other configuration uses the right and left halves of the monitor to present wide circular FOV stimuli to the subject. The top/bottom optical configuration has been installed and is being aligned and tested. Additional light control components are being designed and fabricated.

The luminance uniformity of the HP 9000 high resolution color monitor was measured using the Prichard 1980/HP9845 measurement system. The middle portion of the display has a variation of +/-10% and the upper and lower regions of the display have illuminance variation of +/-5%. These variations are acceptable for the visual stimulus presentations and the experimental design was adapted to control for the luminance variations.

A series of computer programs have been written for the HP 9000 to generate visual stimuli for the binocular overlap study. The stimulus generation programs present the display conditions required to simulate various binocular overlap viewing conditions. These include biocular, monocular, and binocular overlap viewing conditions. Sensitivity of the visual system under the various viewing conditions will be investigated with probe stimuli, quasi-Gabor patches at various spatial and temporal frequencies. These stimuli have the characteristic of being relatively

frequency as well as the spatial and temporal domains. These stimuli are circular patches produced by modulating a spatial sine wave pattern with a single, circular half-wave sine amplitude envelope at one fourth of the spatial frequency. The resulting circular patch contains four cycles of the sine wave modulated by the lower spatial frequency envelope to eliminate sharp patch borders. The temporal modulation is also sinusoidal.

A draft protocol was circulated to the USAARL Scientific Review Committee members for an informal review. The review proved to be very beneficial. The protocol will be revised to incorporate additional data from pilot trials. These trials will provide procedural details on inter-trial interval, number of trials to generate statistically reliable thresholds, and definite spatial and temporal frequency values rather than ranges. The formal protocol will be submitted to the USAARL Scientific Review Committee members during the next quarter.

12. Milestones

The static IHADSS physical measurement data was presented at the SPIE Conference in April 1992, on schedule. The software required to begin dynamic IHADSS data collection has been developed and will be tested during the next quarter. CRT performance data at 525, 875, and 1029 line rates are needed before we begin testing the dynamic MTF procedures. The Comanche may be using a high line rate (1024-9) and we want to ensure our measurement hardware provides reliable data at that high rate. Some of the GFE display hardware failed during testing and had to be sent out for repair, but there was no adverse impact on the program schedule.

The Hewlett-Packard (HP) hardware and software support contracts acquisition process was terminated by Procurement due to a lack of responsiveness by HP. Some additional programming time was required due to the lack of HP support.

A draft protocol was circulated to the USAARL Scientific Review Committee (SRC) members for an informal review. A revised protocol will be submitted early next quarter for SRC approval so formal psychophysical data acquisition can begin next quarter.